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CLAIMS:

1. A method for retrieving information from a three dimensional storage medium, the method comprising:

using a three dimensional storage medium comprising an active medium
5 capable of being in two states, wherein a data unit is represented by the ratio between the concentration of the first and second of said two states in a given volume portion of said medium and a data sequence is represented by a sequence of such data units;

irradiating said active medium with light as to concentrate light flux
10 through a volume portion of said storage medium so as to generate in said volume portion a detectable non-linear optical response characteristic of said concentration ratio;

detecting said non-linear optical response to retrieve information stored in said volume portion; and

15 tracking a data sequence for retrieving said data sequence in a reproducible manner.

2. The method according to Claim 1, wherein the said non-linear optical response is related to a $\chi^{(n)}$ process, where n is greater than 2.

3. The method according to Claim 1 or 2, wherein the active medium
20 includes stillbene derivatives, azobenzene derivatives, or mixtures thereof.

4. The method according to Claim 3, wherein the active medium is embedded in a supporting matrix.

5. The method according to Claim 4, wherein the active medium is doped into the supporting matrix.

25 6. The method according to Claim 4, wherein the supporting matrix is a polymer.

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7. The method according to Claim 6, wherein the active medium is a monomer co-polymerized with the supporting matrix.

8. The method according to any one of Claims 4 to 7, wherein the supportive matrix is transparent to the light irradiated on it and to the light generated by the
5 non-linear optical process.

9. The method according to any one of Claims 4 to 8, wherein the supportive matrix comprises polyethylene, polypropylene, polycarbonate, and/or polymethylmetacrilate (PMMThe), and/or other transparent polymeric material.

10. The method according to any one of Claims 1 to 9, wherein the irradiated
10 light is focused to a spot having a radius of the order of 30 μm of said irradiated light or less.

11. The method according to any one of Claims 1 to 10, wherein the intensity of the irradiated light is high enough for the generated signal to be independent thereon.

12. The method according to any one of Claims 1 to 11, wherein the non-linearly generated light is separated from other light signals that may exist in the environment by a filter, prism, monochromator or any other optical element
15 known in the art.

13. The method according to any one of Claims 1 to 11, wherein the non-linearly generated light is separated other light signals that may exist in the
20 environment by satisfying phase matching conditions.

14. The method according to any one of Claims 1 to 11, wherein the non-linearly generated light is separated from other light signals that may exist in the environment by phase sensitive detection, a low-noise amplifier, a lock-in
25 amplifier, a box-cars, gated averaging methods or any electronic method known in the art.

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15. The method according to any one of Claims 1 to 14, wherein the large flux in the volume portion from which information is retrieved is achieved by focusing two or more collinear light beams at said volume portion.

16. The method according to any one of Claims 1 to 15, wherein the large
5 flux in the volume portion from which information is retrieved is achieved by intersecting two or more focused light beams, each of which is monochromatic.

17. The method according to any one of Claims 1 to 16, wherein the non-linear optical process is a multi photon fluorescence process.

18. The method according to Claim 17, wherein the non-linear optical process
10 is a two-photon fluorescence process.

19. The method according to any one of Claims 1 to 16, wherein the non-linear process is selected from Coherent Anti-Stokes Raman Scattering (CARS), Degenerate Four-Wave Mixing (DFWM), Raman Induced Kerr Effect Spectroscopy (RIKES), and/or other four-wave mixing processes.

20. The method according to any one of Claims 1 to 19, wherein the data
15 sequence is tracked via a tracking feedback signal for directing the light spot to a predetermined volume portion of the storage medium.

21. The method according to Claim 20, further including correcting tracking errors in the optical storage medium by:

- 20 (a) directing a reading spot that is nominally focused on to a track in the optical storage medium,
- (b) continually moving the reading spot in axial and radial directions,
- (c) receiving a signal having an amplitude which varies according to respective offsets from the track in radial and axial directions,
- 25 (d) using the received signal to determine a direction of a respective offset from the track in radial and axial directions, and

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(e) adjusting a location of the reading spot accordingly.

22. The method according to Claim 21, wherein directing the reading spot includes directing at least two light sources whose volume of intersection constitutes the reading spot.

5 23. The method according to Claim 21 or 22, wherein moving the reading spot includes modulating a position of the reading spot with a cyclic function.

24. The method according to Claim 23, wherein the cyclic function is substantially sinusoidal.

10 25. The method according to any one of Claims 21 to 24, wherein receiving a signal includes:

- i) reading a data signal with the reading spot,
- ii) multiplying the data signal by a cyclic modulation signal to form a modulated data signal, and
- iii) low pass filtering the modulated data signal.

15 26. The method according to Claim 25, wherein low pass filtering includes window integrating the modulated data signal.

27. The method according to any one of Claims 1 to 26, further including analyzing and processing detected signals and retrieving information therefrom.

20 28. An apparatus (100) for retrieving information from a three dimensional storage medium, the apparatus comprising:

a mount (202) for mounting thereon a three dimensional storage medium (102) comprising an active medium capable of being in two states, wherein a data unit is represented by the ratio between the concentration of the first and second of said two states in a given volume portion of said medium and a data sequence is
25 represented by a sequence of such data units;

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at least one source of coherent light (104, 106) for irradiating said active medium with light as to concentrate light flux through a volume portion of said storage medium so as to generate in said volume portion a detectable non-linear optical response characteristic of said concentration ratio;

5 a detector (120) for detecting said non-linear optical response to retrieve information stored in said volume portion; and

 a tracking unit (125) for tracking a data sequence for retrieving said data sequence in a reproducible manner.

29. The apparatus according to Claim 28, wherein said non-linear optical
10 response characteristic is selected from wavelength, polarization, and propagation direction.

30. The apparatus according to Claim 28, wherein the at least one source of coherent light includes an active light source.

31. The apparatus according to Claim 30, wherein the active light source is a
15 laser.

32. The apparatus according to Claim 28, wherein the at least one source for coherent light includes a passive light source.

33. The apparatus according to any one of Claims 28 to 32, further including an algorithmic error detector (128) for analyzing and processing detected signals
20 and retrieving information therefrom.

34. The apparatus according to any one Claims 28 to 33, wherein the tracking unit (125) is adapted for tracking the data sequence via a tracking feedback signal for directing the light spot to a predetermined volume portion of the storage medium.

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35. The apparatus according to Claim 34, wherein the tracking unit (125) includes a tracking error correction unit for correcting tracking errors, the error correction unit comprising:

a position modulator (332) for modulating a position of the reading spot,

5 an error determination unit (333) for receiving a data signal having an amplitude which varies according to respective offsets from the track in radial and axial directions, and is responsive to the data signal to determine a direction of a respective offset from the track in radial and axial directions, which offsets may be fed to the optical unit to correct radial and axial position errors of the reading
10 spot.

36. The device according to Claim 35, wherein the reading spot is a volume of intersection of at least two light sources focused on the track.

37. The device according to Claim 35, wherein the position modulator is adapted to modulate a position of the reading spot with a cyclic function.

15 38. The device according to Claim 37, wherein the cyclic function is substantially sinusoidal.

39. The device according to any one of Claims 35 to 38, wherein the error determination unit includes:

a multiplier (340) for multiplying the data signal by a cyclic modulation
20 signal to form a modulated data signal, and

a low pass filter (341) for low pass filtering the modulated data signal.

40. The device according to Claim 39, wherein the low pass filter is a window integrator (341).